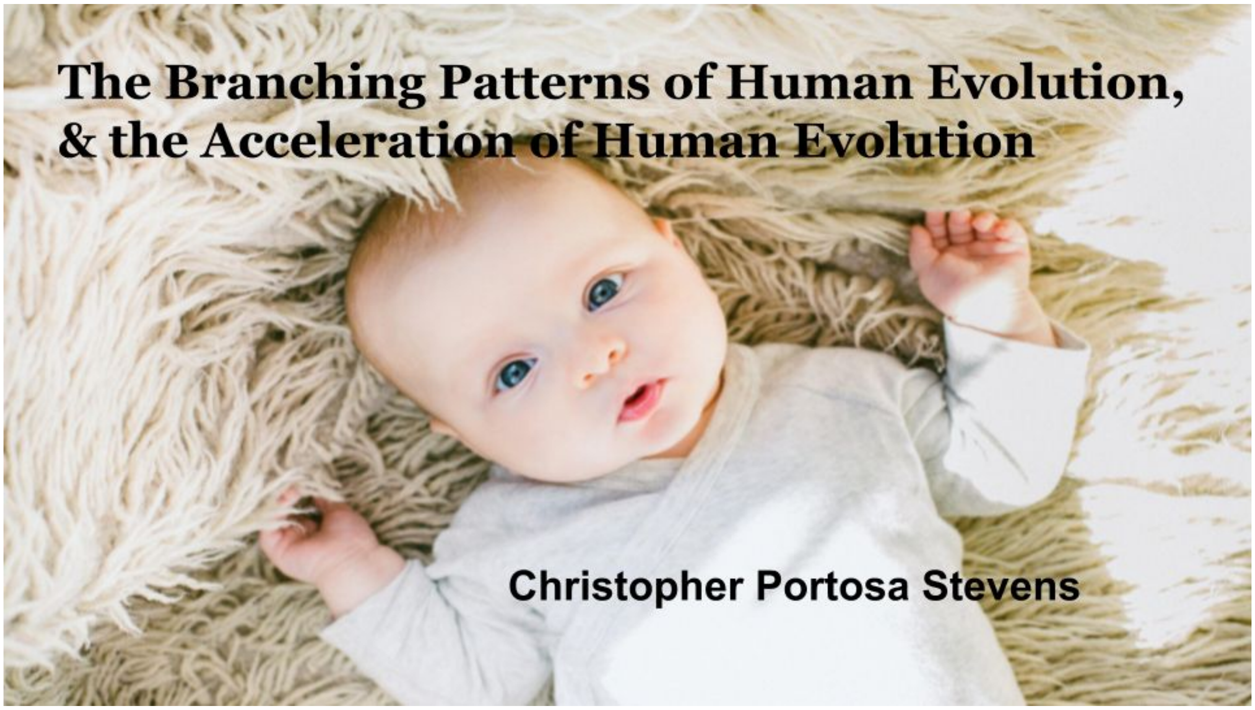
The Branching Patterns of Human Evolution,
& the Acceleration of Human Evolution
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Abstract:

Given that natural selection is commonly treated as a constant or near constant across species (such as across primate species and the human species), and given that comparing clones to a natural population of the human species identifies assortative mating as a variable (i.e., natural populations have more assortative mating across categories of dissimilar characteristics and similar characteristics than populations of genetic identicals or clones), I propose that increasing assortative mating may explain greater brain encephalization, greater brain complexity, and greater diversity of behavioral characteristics in the evolution of species, including humans compared to primate species, sea mammals compared to fish, and bird species (including flight, song, and greater parental investment) compared to reptiles. Moreover, since this strategy of predictive science may be used to visualize branching patterns, I discuss how this strategy of predictive science may complement conventional reductionism in science.

Keywords: ***branching patterns cloning assortative mating evolution positivism alternation of functions***

The Branching Patterns of Human Evolution, and the Acceleration of Human Evolution

1. Introduction: I seek to demonstrate an unrecognized branching pattern or series of branching patterns in the human species by way of a comparison of a population of clones to the natural population from which the clones are derived: In the case of an individual human organism taken at random and cloned to produce a population of clones (such as a 1,000 or a 1,000,000), it is possible to predict that the distribution of characteristics of the natural population would collapse in the generation of clones.[1] In the human species this distribution of characteristics across individual organisms in any generation is part of a larger branching pattern or series of branching patterns (faces, physical characteristics, and behavioral characteristics): That is, there is an increasing number and differentiation of faces and facial characteristics, physical characteristics (including across body types, ectomorphs, mesomorphs, and endomorphs), and behavioral characteristics including intelligences, personality characteristics, and talents from the earliest human societies to contemporary human societies, including across various ethnic, linguistic, and racial groups. In alternative terms, I seek to identify what Charles Darwin called the "diversity of mental faculties of men" or the diversity of mental faculties across individuals as being part of a larger branching pattern of characteristics including facial and behavioral characteristics in the evolution of the genus *Homo*.[2]

The co-discoverer of the theory of evolution by natural selection, Alfred Russel Wallace, argued that natural selection in itself did not explain the existence of higher intelligence -- or higher intelligences -- in humans (or "the diversity of mental faculties in men" as Darwin called them). This is because, in Wallace's view, the theory of natural selection explained the conservation of adaptive characteristics that emerged to meet immediate or near immediate needs and wants of the organism and the larger species of which the breeding population of organisms was a part. Thus, Wallace argued that from the standpoint of natural selection the higher intelligence of humans was an extravagance compared to the adaptive characteristics that emerged from natural selection to meet immediate or near immediate needs and wants presented by the environment. Wallace

states that the “laws of evolution” in their “essence” generate in species “a degree of organization exactly proportionate to the wants of each species, never beyond those wants.” In Wallace’s view, “natural selection could only have endowed savage man with a brain a few degrees superior to that of an ape, whereas he actually possesses one very little inferior to that of a philosopher.”[3]

Branching patterns are fundamental to science, their simulation and abstraction in computer science, and many phenomena across “branches” of science are considered or classified as branching patterns:[4-6] this includes the tree of life, cellular differentiation and growth in plants, cellular differentiation and growth of lungs, muscle-skeletal systems, circulatory systems, brains, or other tissues and organ systems in animal organisms, branching patterns of characteristics across individual organisms within species, branching patterns of characteristics and adaptive structures across species, languages and linguistic groups, religions and religious sects, families, organizations, networks of computers and electronic devices, fields and branches of science, fields and branches of philosophy, and human societies themselves.

No Darwinist or neo-Darwinist has ever attempted to identify, recognize, or explain the branching pattern of an increasing number and differentiation of faces and facial characteristics, body types and physical characteristics, and behavioral characteristics including intelligences, personality characteristics, and talents, its emergence and diversification as a branching pattern or series of branching patterns in human evolution, or its potential isomorphism with increasing brain encephalization and increasing structural and functional differentiation in the brain. If Darwinism does not explain or identify the existence and emergence of these patterns, what does?

Scientists have long suggested that factors in addition to natural selection shape and organize biological characteristics in the evolution of species, and that culture may play a role in shaping and organizing brain encephalization and structural and functional differentiation in the brain. Given that natural selection is commonly treated as a constant or near constant across species (such as across primate species and the human species), and given that the comparison of clones to a natural population identifies assortative mating as a variable (i.e., natural populations have more assortative mating across categories of dissimilar characteristics and similar characteristics than populations of genetic identicals or clones), I propose that increasing assortative mating

may explain greater brain encephalization, greater structural and functional differentiation in brains, and greater diversity of behavioral characteristics in the evolution of species, including humans compared to primate species, sea mammals compared to fish, and bird species (including flight, song, and greater parental investment) compared to reptiles.

Thus, since Darwinism or natural selection is commonly treated as a constant or near across primates and the human species, I suggest that the principle of organization of this larger branching pattern in the human species is assortative mating; moreover, I seek to develop an explanation of this larger branching pattern based on the co-evolution of culture and the human biology of the brain, including increasing assortative mating and increasing culture in the evolution of the genus *Homo* and the human species.

2. In a Comparison of a Population of Clones to a random sample of the Natural Population from which the Population of Clones was derived, a number of quantities are reduced: If a human individual taken at random was cloned to produce a population of clones (such as cloning an individual to produce a 1,000 or a 1,000,000 genetic identicals or clones), it is possible to predict that the distribution of characteristics of the natural population would collapse in the population of clones, and that there would be a reduction in the number and differentiation of faces and facial characteristics, physical characteristics (including body types endomorphs, mesomorphs, and ectomorphs), personality characteristics, and also the number and differentiation of intelligences and talents across the population of genetic identicals or clones compared to a random sample of the natural population from which the clones were taken, derived, or modeled.

Thus, in the case of an individual taken at random, *and given the nature of genetic inheritance*, the resulting population of clones would have identical or nearly identical faces, and also identical or nearly identical or highly similar sets of personality characteristics, talents, and intelligences; thus, the resulting population of clones or genetic identicals would have fewer faces, fewer personality characteristics, fewer intelligences and talents than a random sample of individuals of a similar size taken from the same ethnic group or racial group of the clone, or from the larger natural population of the species itself.

There also would be less assortative mating. There would be less assortative mating because the number of characteristics across individuals would be reduced; that is, the number of dissimilar characteristics would collapse in a generation of clones, and the number of categories of similar characteristics would be reduced in a population of clones compared to a random sample of a the natural population from which the clones were taken, derived, or modeled. (Assortative mating includes mating and interaction of 'like with like' or mating across similar characteristics, and also mating and interaction across dissimilar and complementary characteristics, sometimes popularly referred to as 'opposites attract'). Consequently, assortative mating as a quantity may be identified. (Here, I simply want to establish that assortative mating as a quantity can be established, and that in the case of an individual taken at random that was cloned to produce a population of genetic identicals or clones, there would be less assortative mating in a generation of clones compared to a random sample of a population of similar size taken from the same ethnic or racial group or the population at large).

3. Cloning reduces or collapses quantities and qualities that have been increasing in human evolution: The comparison of a generation of clones to the natural population from which the clones were derived also implies that if a number of quantities can be reduced, including the number and differentiation of faces and facial characteristics, personality characteristics, talents, intelligences, and also assortative mating, then it is *in principle* possible to increase these quantities.

It is also possible to reverse the logic of this comparison, or consider the comparison of clones and natural populations from the standpoint of human evolution: Human evolution itself involves increasing the qualities and quantities reduced in the comparison of clones and natural populations, and involves increasing the size and diversity of the branching pattern that collapses in the generation of clones; that is, the earliest human populations had fewer faces and facial characteristics (such as eye, nose, chin, cheek, and forehead positioning, chin and cheek dimples, hair colors, eye colors, and hair textures and patterns), fewer physical characteristics (including the spectrum of body types across ectomorphs, mesomorphs, and endomorphs), and also fewer personality characteristics, intelligences and expressed talents than contemporary human societies that manifest a greater number, differentiation, and dispersion of faces

and facial characteristics, body types and physical characteristics, and personality characteristics, intelligences, and expressed talents.

4. The Co-Evolution of Biology and Culture in the Genus *Homo*: Eminent biologist Edward O. Wilson, in his *Sociobiology,*[7] provides a classic discussion of a paradox of human evolution: Darwinism posits that evolution is intensely gradual; however, the evolution of species in the genus *Homo* is faster than the evolution of primates and various mammals, and the evolution of *Homo Sapiens* is faster than the evolution of primordial human species in the genus *Homo*:

“The cerebrum of *Homo* was expanded enormously during a relatively short span of evolutionary time . . . Three million years ago *Australopithecus* had an adult cranial capacity of 400-500 cubic centimeters, comparable to that of the chimpanzee and gorilla. Two million years later its presumptive descendant *Homo erectus* had a capacity of about 1000 cubic centimeters. The next million years saw an increase to 1400-1700 cubic centimeters in Neanderthal man and 900-2000 cubic centimeters in modern *Homo sapiens*. The growth in intelligence that accompanied this enlargement was so great that it cannot yet be measured in any meaningful way . . . no scale has been invented that can objectively compare man with chimpanzees and other living primates.” [cf. 8-10]

Wilson’s discussion of these patterns also suggests that the branching pattern identified above extends across the genus *Homo*, i.e., the branching geometry of an increasing number and differentiation of faces and facial characteristics, and also behavioral characteristics including personality characteristics, talents, and intelligences goes back not only to the earliest populations of *Homo Sapiens* but also goes back to early primordial human species within the genus *Homo* as well.

Moreover, Wilson’s discussion of these patterns implies that the evolution of species in the genus *Homo* is faster than the evolution of primates and other animals, particularly in terms of brain encephalization, and the evolution of the human species is faster than the evolution of primordial human species in the genus *Homo*.

These patterns are counterintuitive from the standpoint of Darwinism since Darwin’s theory of evolution by natural selection argues that evolution is intensely gradual. (Darwin comments that “natural selection will always act with extreme slowness,” and

also invokes the Latin principle of "Natura non facit saltum"). Darwin places great emphasis on the gradual nature of evolution in *The Origin of Species,*[11] and this standpoint has been re-emphasized by contemporary Darwinists: For example, in criticisms and replies to proponents of Neutral Theory in evolutionary biology, i.e, there are Darwinist adaptionists that argue natural selection is so gradual and conservative that the "neutral" or non-adaptive evolution of genetic information established by geneticist Motoo Kimura and his colleagues is faster than highly conservative, slower, and even comparably static evolution of genes responsible for the development of particular proteins, tissues, and organs that serve particular adaptive functions in various species.[12] Darwinism seeks to explain the gradual nature of evolution and the conservation of adaptive characteristics; however, as E.O.Wilson shows, some rates of evolution across species are faster than others.

Biochemist Nick Lane[13] comments that, "the problem is that science is all about predictions . . . Biology is less predictive, and has no laws to compare with those of physics. . . the predictive power of evolutionary biology is embarrassingly bad . . . I do not mean by this that evolutionary theory is wrong -- it is not -- but simply that it is not predictive." [cf. 14] Lane's criticism may be related to Darwin's natural selection being treated as a constant or near constant across species when it is discussed as a force of evolution, or as a constant or near constant across species with sexual reproduction; however, as discussed above, some rates of evolution are faster than others.

I shall seek to provide an explanation for the increasing rate of evolution in the genus *Homo* and in the human species, and for the increasing number and differentiation of faces and facial characteristics, personality characteristics, and the number and differentiation of intelligences within the genus *Homo* and the human species. Given the nature of genetic inheritance, I suggest that the principle of organization of the branching pattern or branching geometry of an increasing number and differentiation of characteristics in the human species is assortative mating.

Assortative mating and culture are not constants in the evolution of the genus *Homo*, they have been increasing. The comparison of populations of clones to natural populations identifies a number of quantities including assortative mating (they are identified since they are reduced in a generation of clones compared to the natural population from which the clones are derived or modeled). What increases assortative

mating? Culture. Culture increases the qualities across individuals in the human species, and the genus *Homo* more generally, compared to primates and other animals (elaborated below).

It should be recognized that I do not seek to discard natural selection as an explanation of evolution; however, intraspecific assortative mating and increasing culture may generate larger branching patterns of characteristics than natural selection on its own (similarly, interspecific assortative mating between angiosperm plants and bee species, insect species, and bird species may generate larger branching patterns or branching geometries of characteristics across species of angiosperm plants compared to ancestral species of plants that do not participate in assortative mating with bee, insect, or bird species).

In the following section I shall discuss how, in the co-evolution of human biology and culture, assortative mating is increased by culture and cultural growth.

5. Assortative Mating and Culture: As suggested by the comparison of populations of clones to natural populations, it should be appreciated that my concept of assortative mating is more general than earlier conceptions that focus on assortative mating by height, wealth, and intelligence scores. *Culture, including language, increases the number and differentiation of qualities across individuals, and thus culture and language increase assortative mating by increasing the number and differentiation of qualities across individuals*:[1,15-26] The more culture, the more similarities or categories of similar characteristics across individuals (for the mating of 'like with like'), and the more culture, the more categories of dissimilar characteristics across individuals (mating across dissimilar characteristics or complementary characteristics is also popularly recognized as 'opposites attract').

Thus, culture increases assortative mating by increasing the number of similar characteristics and dissimilar characteristics across individuals, including roles in a division of labor, roles in an economy with increasing technological differentiation, or likes and affinities for gods, goddesses, God, dance, music, or other cultural phenomena. Culture includes different kinds of secular culture, such as art, theatre, film, music, science, philosophy, literature, fashion, dance, and cuisine; religious culture, such as religious rituals and practices, literary canon, sects, churches, schools, and also similar or varying interpretations of God and religious persona across individuals and groups;

language, customs, and ethnicity, including linguistic dialects and regional accents, and also customs, practices, and values many times associated with languages, and also regional dialects, accents, and ethnicity; material culture, including technology and technological differentiation across a division of labor, organization, or larger economy. In the co-evolution of culture and biology, the more culture, the more potential qualities across individuals and groups, and the greater the capacity for assortative mating across individuals (and also across groups, as in assortative mating between simple societies in the evolution of primordial humans and humans in the genus *Homo*).

The more culture, the greater the capacity for assortative mating; the more culture, the more assortative mating across similar characteristics (since there are more categories of similar characteristics across individuals) and dissimilar characteristics or complementary characteristics (since there are also more different characteristics across individuals as culture increases). Thus, ***culture increases assortative mating.***

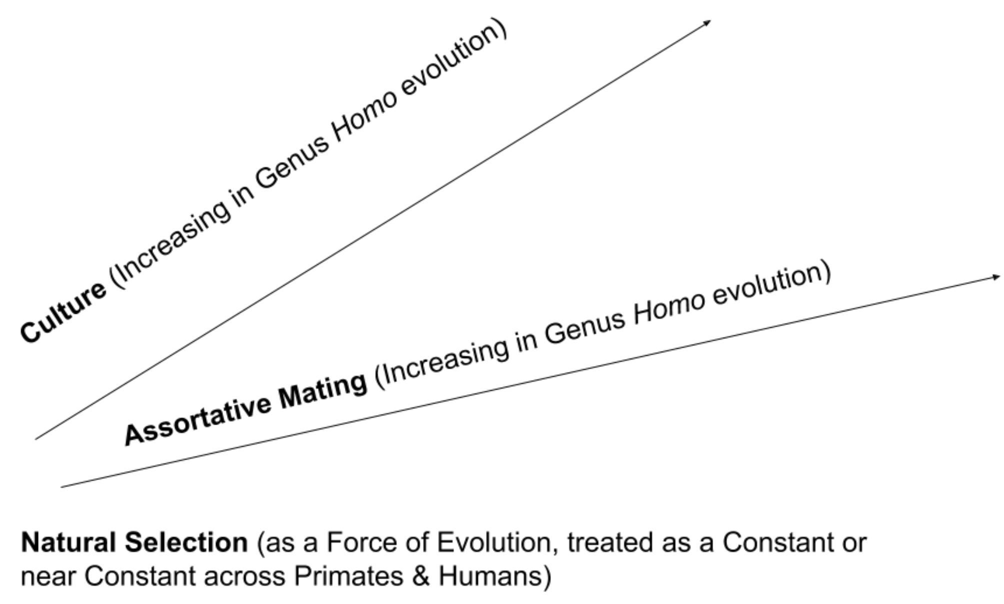


Figure 1: Fundamental Patterns: Natural Selection as a Constant or Near Constant Across Primates & Humans: Assortative Mating Increasing in the Genus Homo: Culture Increasing in the Genus Homo.

6. Explaining Brain Encephalization: Returning to the pattern discussed by Edward O. Wilson of an increasing rate of brain encephalization in the genus *Homo*: This approach introduces a new explanation for the increasing rate of evolution in the genus *Homo* (compared to primates and animals), and also the acceleration of evolution in the human species (particularly in terms of brain encephalization in humans compared to primordial species in the genus *Homo* and also compared to primates and animals). Culture increases assortative mating: Early primordial human species of the genus *Homo* had more culture (such as early tool use and tool making, and, possibly, early expressive culture such as singing, early speech, and dance) than primates and animals, and also more assortative mating.

As suggested, a similar process occurs with *Homo Sapiens*, though humans have more spectacular achievements in culture and cultural growth across the evolution of human societies, with, as anthropologists have demonstrated, relatively slow rates of cultural growth in the early evolution of human societies, and then more spectacular and more rapid cultural growth since early human settlements and the Neolithic revolution: symbolic and expressive culture including writing systems, religious systems, art, architecture, music, dance, theatre, poetry, literature, philosophy, and science, and also material culture, as in technological inventions and technological growth related to horticultural and agricultural production, the production of clothing and textiles, and the production and technological growth in instruments for communication, music, hunting, and warfare. (William Ogburn was the first to suggest that cultural growth in human evolution is exponential: extremely slow cultural growth including technological growth in early simple societies for much of human evolution, and since the neolithic revolution approximately 10,000 years ago, comparatively fast cultural and technological growth as the mass or base of culture and inventions, the capacity for cultural diffusion, and potential combinations across technologies and inventions, increases; there are debates in the literature as to whether specific sets of technologies, or contemporary societies themselves, may plateau in their technological development and growth).[16, 27-28]

Is increasing brain encephalization and increasing structural and functional differentiation within the brain tied to increasing culture and cultural growth in the

evolution of human societies? If they are, are they connected by more than what physicists call "action at a distance"?

The present theory implies that, since culture increases assortative mating, and since humans have more culture and cultural growth than primordial human species in the genus *Homo* and also more culture than more distantly related primate species, humans have even more assortative mating across categories of dissimilar characteristics and similar characteristics than primordial human species (such as *Australopithecus* or *Homo Erectus*); consequently, over generations of human evolution they have developed a greater number and differentiation of faces and facial characteristics, physical characteristics including body types, and personality characteristics, intelligences and talents. This is an acceleration of human evolution: It is an acceleration of human evolution compared to proto-humans in the genus *Homo*, and also compared to primate species; it also involves an increasing diversity and differentiation of characteristics across human populations.

7. Brain Encephalization, Cultural Growth, and the Geometry of Faces: The present work and theory provides a new explanation compared to Darwinist and neo-Darwinist explanations in neuroscience, psychology and cognitive science of the evolution of the brain, mind, and brain encephalization in the human species. For example, the influential psychologist and computer scientist Marvin Minsky comments that, "one reason that our mammalian brains have so many different specialized 'centers' must be that as our ancestors evolved, their brains had to develop new mechanisms to adapt to new ecological niches, whereas most other animals failed to evolve multiple different 'ways to think.'"[29] Neuroscientist Gerald Edelman also is a proponent of a neo-Darwinist perspective, sometimes called "neural Darwinism," in explaining brain encephalization and even consciousness itself: "At some time around the divergence of reptiles into mammals and then into birds, the embryological development of large numbers of new reciprocal connections allowed rich reentrant activity to take place . . . consciousness arises as a result of integration of many inputs of reentrant reactions in the dynamic core . . . Selection occurs among a set of circuits in the core repertoire."[30] Biochemist and neuroscientist Francis Crick argues that multiple perspectives and frameworks may be required to gain a greater understanding of the nature and emergence of consciousness, including competition amongst coalitions: "the various neurons in a coalition in some sense support one another, either directly or

indirectly, by increasing the activity of their fellow members. The dynamics of coalitions are not simple . . . at any moment the winning coalition is somewhat sustained, and embodies what we are conscious of."[31]

Another strategy is to consider the evolution of the brain and brain encephalization in their relationship to cultural growth, cultural diversification, and the increasing geometry of faces within linguistic and ethnic groups, and also across societies. It is possible to conjecture that there is an isomorphism in the co-evolution of culture and biology: the increasing internal structural and functional differentiation and neuronal plasticity of the brain of biological evolution in the genus *Homo* partly resembles and is isomorphic with the increasing cultural growth and differentiation of human societies, and also the increasing number and differentiation of characteristics across human faces, physical characteristics and body types, and also personality characteristics, intelligences, and latent and expressed talents.

More generally, this theory explains greater brain encephalization, and greater structural differentiation and functional differentiation of human brains compared to the brains of members of primate species and various animal species, with the co-evolution of human biology with increasing culture and assortative mating.

In this work I have attempted to link the emergence of higher intelligences to two main patterns: the increasing geometry of faces, capacities, and intelligences -- these include faculties for language acquisition and an inner conscious "voice" -- is isomorphic with increasing brain encephalization including increasing structural and functional differentiation and neuronal plasticity in the brain. The increase and acceleration of brain encephalization, and also the branching pattern of an increasing number and differentiation of faces, intelligences, personality characteristics, are explained by culture and assortative mating instead of natural selection on its own. As suggested, natural selection, as a force of evolution, is commonly treated as a constant across species, and is commonly treated as a constant in those fields that attempt to extend Darwinist or neo-Darwinist explanations to human behavior (including sociobiology, evolutionary psychology, evolutionary linguistics or neo-Darwinist linguistics, and neo-Darwinist philosophy).

There is a branching pattern or collection of branching patterns across linguistic groups in the evolution of the human species: There is an increasing number and differentiation

of faces and facial characteristics, body types and physical characteristics, and behavioral characteristics including personality characteristics, intelligences, and talents. As suggested, the principle of organization of this larger branching pattern or branching geometry of characteristics is assortative mating. It is possible to ask: what increases assortative mating? Culture. Culture increases the qualities across human individuals within linguistic groups and ethnic groups, and, more generally, across the human species itself. Thus, given the nature of biological inheritance, culture and assortative mating explain *the acceleration* of human evolution (compared to the evolution of chimpanzees and primates). Culture and assortative mating increase brain encephalization including structural and functional differentiation in the brain in the genus *Homo* and in the human species, and culture and assortative mating also explain the increase and expansion of the branching geometry of an increasing number and differentiation of faces and facial characteristics, and also behavioral characteristics including intelligences, personality characteristics, and talents.

More generally, in the evolution of the Genus *Homo*, the geometrical area of faces and facial characteristics have increased from the earliest primordial species in the Genus *Homo* to contemporary societies of the human species with a far greater range and diversity of faces and facial characteristics than the earliest human societies, and, by implication, earlier societies in the evolution of the Genus *Homo* (i.e., eye, nose, chin, and cheek positioning, eye colors, hair colors, hair types and textures, and chin and cheek dimples). Though they may be more difficult to measure than the phenotypic and physical diversity of faces and facial characteristics across different linguistic groups and ethnic groups, the geometrical area of behavioral characteristics also has increased in the evolution of the Genus *Homo*. The earliest primordial human species, or even the earliest human societies, compared to contemporary human societies expressed far fewer behavioral characteristics than contemporary human societies, i.e., intelligences, talents, capacities, and personality characteristics that may be expressed in human interaction, displays, productivity, labor, war, or as individuals and groups take different roles in a division of labor in a family, organization, or larger economy. From the standpoint of the evolution of the genus *Homo*, the increase in the expression and manifestation of behavioral characteristics in primordial human species and the human species is an increase in the branching pattern or branching geometry of behavioral characteristics, i.e., intelligences, talents, capacities, and personality characteristics.

Note that the geometrical area of body types and physical characteristics has similarly increased in the evolution of the genus *Homo*, though not as great as faces and facial characteristics, or behavioral characteristics, i.e., intelligences, talents, capacities, and personality characteristics, in the evolution of the Genus *Homo* and the human species.

Since Darwin, there has developed a large literature in the biological sciences, and also philosophy, psychology, and related fields that attempts to explain behavioral characteristics, intelligences, and emotions in terms of Darwinism: These include the emergence of higher intelligence, language, an innate capacity for language learning, personality characteristics and emotions, and the emergence of consciousness itself in terms of natural selection. As discussed, Darwin's co-discoverer Alfred Russel Wallace viewed natural selection as explaining the conservation of adaptive properties that met the immediate needs or requirements for an organism's' survival and reproduction, and questioned whether natural selection itself could explain the rise and emergence of higher intelligences and faculties in humans that served no immediate needs. Similarly, influential linguist Noam Chomsky, in his earlier work, questioned whether Darwinism or natural selection explained the emergence of higher intelligences including an innate language capacity, and did not use Darwinism as an explanation for the emergence of an innate language capacity.[32, cf. 33-34]

This work introduces a new explanation. The "diversity of mental faculties" to which Darwin referred, including an innate language capacity, are part of a larger branching pattern or branching geometry of intelligences, capacities, talents, and personality characteristics of the human species. The principle of organization of this branching pattern is assortative mating; moreover, given genetic inheritance, the co-evolution of human biology with increasing culture and increasing assortative mating explains the increasing number and differentiation of faces and facial characteristics, and also behavioral characteristics including intelligences, personality characteristics, and talents across the branching pattern or series of branching patterns of human evolution (compared to primate species in which assortative mating within a shared language is absent, and compared to primate species and animal species in which assortative mating across cultural characteristics is absent or at least far less developed than in humans).

The discussion in this section also may be connected to E.O. Wilson's work discussed above: Connecting the theory of assortative mating to E.O. Wilson's classic discussion of patterns in the evolution of the genus *Homo* also implies that the larger branching pattern of the Genus *Homo*, or series of branching patterns or branching geometries of the Genus *Homo* and the human species, have been accelerating and diversifying faster than the evolution of characteristics across individual organisms in chimpanzee species or other primate species; by contrast, sociobiologists commonly treat natural selection as a constant or near constant across primates and humans.

8. Explaining Patterns in Brain Encephalization and Assortative Mating: There are a few extensions of the present theory that may be briefly explored: As discussed, above, brain encephalization in humans is faster and greater than brain encephalization in primordial species within the genus *Homo*, and also primates. *Since brain encephalization in humans may be explained by culture and assortative mating, differential rates of assortative mating also may contribute to explaining differential rates and levels of brain encephalization across animal species*. Thus, an avenue for future research is whether animal species with greater brain encephalization or greater brain complexity have more assortative mating compared to species with less brain encephalization and less brain and central nervous system development**.**

Mammalian species, in general, have more assortative mating in sexual reproduction than other classes of species, and this may explain greater brain encephalization. It is possible to test this idea, such as by performing studies involving random samples of sea mammal species (Cetacea) and other non-mammalian sea-dwelling species such as various species of Agnatha, Osteichthyes, and Chondrichthyes, i.e., primordial fish, bony fish, and cartilaginous fish, sharks, and rays. Assortative mating is present and more developed in the sea mammal species compared to species of Agnatha, Osteichthyes, and Chondrichthyes that practice various forms of spawning and more limited forms of assortative mating compared to sea mammals.

Even though there are comparatively fewer species of Cetacea in relation to the larger number and diversity of Agnatha, Osteichthyes, and Chondrichthyes, and the species of Cetacea share relatively similar habitats with large numbers of fish species, the Cetacea have greater brain encephalization, as in the greater brain encephalization of species in the order Cetacea, including dolphin species, orca species, and various whale species.

The greater brain encephalization and emergence of intelligences and talents of some sea mammal species is so developed that members of dolphin species and orca species are capable of interspecific interaction, including playing with humans, and in some cases enjoy "showing off" their talents to their human observers. The demonstration of such behavioral characteristics, intelligences, and talents in social interaction are either not available or far less available to members of species of Agnatha, Osteichthyes, and Chondrichthyes, that is, primordial fish, bony fish, and cartilaginous fish, sharks, and rays.

Darwin and neo-Darwinists have attempted to explain the expression of intelligence and emotions in animals and also humans with natural selection. However, natural selection as a force of evolution is commonly treated as a constant or near constant across species with sexual reproduction.

It is possible to offer a new explanation (that is also connected to the explanation of the increasing geometry of faces, intelligences, and talents in the genus *Homo*): greater brain encephalization and the emergence of greater talents, intelligences, and even emotions and primordial personality characteristics may be explained by greater assortative mating in mammals, including sea mammal species, compared to other classes and orders of species, including primordial fish, bony fish, and cartilaginous fish, sharks, and rays. In contrast, natural selection applies across species of Agnatha, Osteichthyes, and Chondrichthyes, and also species of Cetacea; natural selection as a force of evolution is commonly treated as a constant or near constant across these orders and classes of species.

However, assortative mating is not constant across these orders and classes of species, it is greater in species of Cetacea versus species of Agnatha, Osteichthyes, and Chondrichthyes. Thus, assortative mating provides a theory of evolution complementary to natural selection: assortative mating may generate greater brain encephalization and a greater variety of behavioral characteristics in the evolution of species than natural selection on its own. Moreover, assortative mating also may explain greater brain complexity and greater brain encephalization in birds compared to reptiles (and ancestral dinosaurs): like sea mammals compared to fish, greater assortative mating in birds compared to reptiles may contribute to explaining the greater diversity of physical

characteristics (including plummages and colors) and behavioral characteristics (including flight, song, and greater parental investment) of birds compared to reptiles.

Thus, more generally, given that natural selection is commonly treated as a constant or near constant across species (that is, it is claimed that natural selection explains the evolution of Agnatha, Osteichthyes, and Chondrichthyes, and that natural selection explains the evolution of dolphin species and whale species of Cetacea; that natural selection explains the evolution of Reptilia, Dinosauria, and Aves; that natural selection explains the evolution of primates, primordial species in the Genus *Homo*, and also *Homo Sapiens*), and given that the comparison of clones to a natural population identifies assortative mating as a variable (i.e., natural populations have more assortative mating across categories of dissimilar characteristics and similar characteristics than populations of genetic identicals or clones), I propose that increasing assortative mating may explain greater brain encephalization, greater structural and functional differentiation of brains, and greater diversity of behavioral characteristics in humans compared to primate species, sea mammals compared to fish, and bird species (including flight, song, and greater parental investment) compared to reptiles and dinosaurs.

Note also that if assortative mating is used as an alternative explanation to Darwinian and neo-Darwinian treatments of natural selection and sexual selection, concepts of convergent and divergent assortative mating may be used instead of Darwinian language in the classification and explanation of differential sizes of males versus females, and primary and secondary sexual characteristics, behaviors, capacities, talents, and intelligences of males versus females. That is, greater differences in sizes, and also secondary sexual characteristics, capacities, and talents of members of one sex versus the other in species may be explained as a product of divergent assortative mating. Smaller differences in size, secondary sexual characteristics, behaviors, capacities, and talents of members of one sex versus the other in species may be explained by greater convergent assortative mating compared to divergent assortative mating. (However, in some species, such as in some bird species, these patterns may overlap, as in convergent assortative mating for some characteristics, such as parental investment, and then divergent assortative mating across the sexes by colors, plummages, and song; convergent assortative mating has to do with assortative mating in which characteristics between males and females converge more than in divergent

assortative mating in which the characteristics between males and females have greater differences; the human species has both patterns of convergent and divergent assortative mating, while some species have highly developed patterns of divergent assortative mating in which one sex may be several times larger than the other, or the arms, claws, horns, or secondary sexual characteristics may be several times larger or only present in one sex versus the other). Distinguishing between convergent and divergent assortative mating also may be useful for other purposes in the investigation of biological species; for example, it may be possible to generate new predictive models and test whether speciation is more likely to occur from species with greater convergent assortative mating or greater divergent assortative mating, whether patterns of speciation as a product of divergent assortative mating are different than convergent assortative mating, and whether speciation in the biological record is more likely a product of convergent assortative mating or divergent assortative mating.

9. The Alternation of Functions, Assortative mating, and the Nature of Brain Encephalization: The physical size of heads in humans have reached a plateau, and may actually have shrunk slightly compared to the size of heads of early or archaic humans.[9-10] However, the number and differentiation of faces and facial characteristics (eye, nose, chin, cheek positioning, eye colors, hair colors, hair textures, and chin and cheek dimpling) have been increasing even as head size has plateaued or shrunk slightly in the evolution of the human species. This suggests that brain encephalization has continued in the form of greater structural and functional differentiation and plasticity in the brain even as head sizes have plateaued or shrunk slightly, and that the continuation of increasing structural and functional differentiation in the brain is isomorphic or partly isomorphic with increasing facial characteristics.

Increasing assortative mating may play a role in increasing the alternation of functions in brain encephalization in the genus *Homo* compared to primates. Since the size of heads has plateaued in the evolution of the human species, and since head sizes may have shrunk slightly in the evolution of the human species from early archaic humans, brain encephalization may continue in increasing structural and functional differentiation of the brain, and increasing alternation of functions across sections of the brain (i.e., groups of neurons of sections of brains may engage in the alternation of functions in ways that skeletal systems and lungs do not).

In nature, sexual reproduction itself involves the specialization of functions across males and female organisms; however, the alternation of functions includes the alternation of generations, as in plant and animal species that have sexual reproduction and also forms of asexual reproduction; the specialization of functions and the sharing of functions are more conspicuous than the alternation of functions; however, there are also different kinds of alternation of functions in divisions of labor: *this may include the alternation of functions by experts and specialists in divisions of labor whereby they perform tasks across more than one specialization or related specializations (they may be "Renaissance men" performing tasks across multiple specialties, or individuals that may have expertise in performing tasks across a set of different though related specializations)*; there is also the limited alternation of functions and sharing of functions between men and women in parental investment and childcare (that varies considerably across societies) in the human species; social organisms may engage in the specialization of functions, the alternation of functions, and the sharing of functions across individuals more than solitary species; the alternation of functions and the sharing of functions may be more developed in some species classes than others, as in *Aves*; cellular differentiation in the emergence and evolution of more complex organisms involves the specialization of functions across cells and cell lines, and tissues and organs; however, in the emergence of brains there is a greater potential for the alternation of functions across different regions of brains compared to other tissues that do not engage in the alternation of functions, i.e., arteries and the circulatory system, lungs, or the skeletal system. (Structural differentiation usually implies functional differentiation and specialization across different structures; however, the different structures or units may engage in the sharing of functions even if they have different structural properties; structural differentiation usually implies functional specialization and specificity across structures; however, different structures may engage in the alternation of functions across their units, and this may increase their functional capacity in ways that are analogous to experts that improve their performance by specializing and performing tasks across more than one function, or a set of related, though different functions; moreover, in principle, different or individual structures may be multi-functional instead of being highly or exclusively specialized).

Conjecture: In the co-evolution of humans and dog breeds, there is greater alternation of functions in the brains of dogs compared to wolves. The co-evolution of humans and

dogs entails interspecific interaction, and the alternation of social interaction from conspecifics (humans with humans and dogs with dogs) to interspecifics (humans and dogs with each other). I thus conjecture that the co-evolution of humans and dog breeds increases the alternation of functions in the brains of dog breeds compared to wolves.

Moreover, from a practical point of view, increasing interspecific interaction between humans and dog breeds serves multiple functions: interspecific interaction with dog breeds increases the strength of humans' natural immune systems, and is thus an alternative to the partial replacement of humans' natural immune systems with the increasing organizational and economic power of pharmaceutical businesses and medical businesses; the provision of a small number of dogs at elementary schools and high schools with which students might interact, for example, might be a useful way of improving natural immune systems, health, and relieving health care costs; moreover, socialization and interspecific interaction in the co-evolution of human populations and dog breeds increases the alternation of social interaction from conspecifics to interspecific interaction: this may increase the alternation of functions in the brains of dogs (compared to ancestral wolves), genetic differentiation related to the behavioral characteristics of dog breeds, and the diversity, range, and specificity of social intelligences in the behavioral characteristics of dog breeds (compared to wolves); the diversity, range, and specificity of social intelligences and behavioral characteristics of dog breeds may involve differential capacities to interact with human adults and children, or the capacities to perform various tasks, such as protecting humans' farms, livestock, houses, pulling sleds, or even hunting with humans; alternatively, socialization and interaction of humans with dogs also increases the alternation of social interaction for humans between conspecific and interspecifics; in the case of the socialization of young people, it may contribute to young people having a greater range of behavioral responses and characteristics than young people that are not socialized to run, play, or interact with dog breeds. (This also may be true for adults, though the comparison between different populations of young people may be more testable than comparisons between adults because the potential differences in the behavioral responses and characteristics between populations may be larger in comparisons between young people that socialize and engage in interspecific social interaction with dogs compared to young people in which such interspecific interaction is absent).

Conjecture: In the evolution of bird species compared to reptile species, there is greater alternation of functions in the brains of birds compared to reptiles (or ancestral dinosaurs). That is, the greater brain complexity of bird species compared to reptile species[35-36] may involve the greater alternation of functions across neurons or sections of the brains of birds compared to reptiles. The greater physical and behavioral characteristics of bird species (i.e., colors, plummages, flight, song, assortative mating, parental investment) may be related to the greater alternation of functions in the brains of birds compared to reptiles (the alternation of functions in brains being an aspect of increasing brain complexity). The greater alternation of functions in the brains of bird species versus reptiles also may be related or partly isomorphic to behavioral patterns: greater assortative mating of birds compared to reptiles, and also behavioral patterns that involve the alternation of functions, as in bird species that engage in the alternation of functions in predation for offspring, nesting, and parental investment (that is itself an aspect of assortative mating in populations of bird species).

10. Darwinism & Cultural Patterns: Many observers have recognized that culture has both Darwinistic and non-Darwinistic aspects. I do not disregard that cultural and technical inventions that increase societal productivity, or a society's capacity for war or the deterrence and avoidance of war, may be conserved and retained in a way that is partly analogous to Darwinism. I also do not disregard that cultural and biological properties that vary, and that differentially contribute to larger branching patterns of which they are a part, are conserved, retained, or eliminated by the branching patterns of which they are a part, such as the branching patterns of adaptive characteristics across organisms from species to species, or the branching patterns of characteristics across languages and linguistic groups, religions and religious sects, or families, organizations, or societies.

As suggested, branching patterns are fundamental to science, and from the standpoint of the theory of natural selection, natural selection shapes and organizes branching patterns of phenomena: this includes the tree of life, cellular differentiation of organisms, branching patterns of characteristics across individual organisms within species, branching patterns of characteristics and adaptive structures across species, and also languages and linguistic groups, religions and religious sects, and families, organizations, and human societies themselves. However, other factors also may play a role in generating and shaping branching patterns, and as discussed in this paper,

assortative mating may generate larger branching patterns of characteristics or branching geometries of characteristics than natural selection on its own. Moreover, observers have recognized that culture, or at least some patterns of culture and cultural variation, are not "Darwinistic": That is, for example, cultural differences are not necessarily comparable to the patterns of biological variation established by Darwin and Alfred Russel Wallace, i.e., that there are constant or near constant slight variations in the characteristics of individual organisms within species (and the more favorable variations are selected and retained). Culture involves differences that may be greater or are not comparable to the slight variations in characteristics across individual organisms within biological species. This involves cultural differences or cultural distances across individuals and groups, such as cultural chasms between different or foreign religions, languages, writing systems, and value systems; it also involves kinds of cultural inequality, such as greater or less formal or informal education between individuals and groups, or greater or lesser expertise or access to expertise across various fields or the division of labor, or greater or lesser access to technology, technological growth, and innovation between individuals and groups.

I thus recognize that *extreme cultural distances reduce assortative mating*, that is, extreme cultural distances reduce assortative mating across individuals, groups, and societies; and I also recognize that extreme cultural inequalities reduce assortative mating across individuals, groups, and societies. In the co-evolution of culture and human biology, some cultural patterns may reduce the genetic diversity of populations: This may happen when cultural contact and diffusion, and population contact and diffusion, are limited or reduced by cultural chasms or barriers, including extreme cultural distances and inequalities, separating or isolating some populations from others.

In some settings, if the human populations are limited, such extreme cultural differences or distances and inequalities may reduce genetic diversity to the point of genetic inbreeding: an extreme case would be the reduction in genetic diversity and consequent genetic inbreeding in royal families in early modern Europe: the royal families were separated by great cultural differences and kinds of inequality from the larger European populations of which they were a part.

However, the major patterns that I am concerned with in this paper (discussed in earlier sections) is that in the co-evolution of human biology and cultural growth, increasing culture increases the number and differentiation of qualities across individuals and groups, and thus increases intraspecific assortative mating. However, I recognize that as culture increases in some societies versus others, or across some individuals versus others, great cultural differences reduce assortative mating across societies that are separated by cultural chasms (such as different religions, languages, writing systems, or value systems), or societies or individuals that have more culture than others (such as individuals and groups in advanced societies versus early simple societies).

Note that the comparison of clones and natural populations given above involves an individual taken at random; however, it is possible to consider cloning an individual that was not taken at random, such as a Leonardo da Vinci or Vitruvian Man with a large number of intelligences, personality characteristics, and talents. The cloned individuals would have sets of intelligences, personality characteristics, and talents that would approach and in some cases exceed the intelligences, personality characteristics, and talents of the population from which the clone was derived.

11. Note on the Geometry of Faces and Darwin's "Abominable Mystery": This work is on the expanding geometry of faces of the genus *Homo*, the increasing number and differentiation of intelligences, personality characteristics, and talents in the genus *Homo*, and also the relationship of this expanding branching geometry of characteristics to the faster rate of evolution in the genus *Homo* and greater brain encephalization compared to primates.

As suggested, I do not seek to discard natural selection as an explanation of evolution; however, intraspecific assortative mating and increasing culture may generate larger branching patterns of characteristics than natural selection on its own, and it should be recognized that analogous patterns may exist in interspecific assortative mating between angiosperm plants and bee species, insect species, and bird species. Such interspecific assortative mating may generate larger branching patterns or branching geometries of characteristics across species of angiosperm plants compared to ancestral species of plants that do not participate in assortative mating with bee, insect, or bird species. This suggests a functional analogy across biological species and biological systems: Interspecific assortative mating and intraspecific assortative mating may generate larger

branching patterns of characteristics across organisms than natural selection on its own (interspecific assortative mating is absent in ancestral species of plants compared to angiosperms, and intraspecific assortative mating within a shared language, shared ethnicity, or cultural heritage is absent or virtually absent in species of primates or other animals compared to humans).

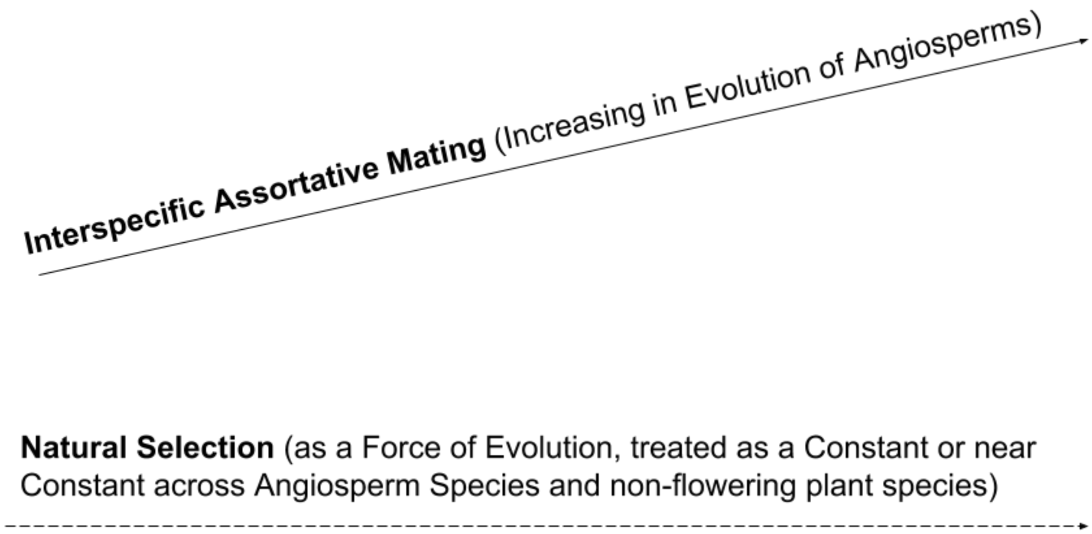
Since in the evolution of the human species the emergence of culture contributes or functions as a way to increase the qualities across individual organisms in the human species, it is possible to consider functional analogies amongst animals and plants: Birdsong, feather colors, and plumage in bird species, and the colors, shapes, and patterns of angiosperm flowering plant species play similar functions in these species, i.e., they increase the number and differentiation of characteristics across individual organisms, thus increasing the capacity for assortative mating across individual organisms in bird species (*intraspecific* assortative mating), and increasing the capacity for assortative mating across angiosperm species and insect species, bee species, and bird species (*interspecific* assortative mating).

It is thus possible to link the co-evolution of culture and human biology to Darwin's "abominable mystery": Darwin's "abominable mystery" was that the faster rate of evolution of angiosperms (complex flowering plants) undermined his principle of gradualism. Alternatively, the expanding geometry of characteristics of complex flowering plants, co-evolving with interspecific assortative mating involving bee species, insect species, and bird species, may be a product of an analogous co-evolutionary process to the expanding geometry of human faces and physical and behavioral characteristics.

Natural selection is commonly treated as a constant across species, or is treated as a constant across species with similar modes of sexual reproduction. Natural selection as a force of evolution is treated as a constant across species such as ancestral species of plants or angiosperms (flowering plants); however, interspecific assortative mating increases in the co-evolution of pollinating flowering plants with bee species, insect species, and bird species. Increasing (interspecific) assortative mating provides a new explanation to the increasing rates of evolution of angiosperms compared to ancestral species of plants, and the increasing geometry of characteristics of angiosperms compared to ancestral species of plants; it also provides a new response and resolution

to Darwin's "abominable mystery" that the the faster rate of evolution of angiosperms does not fit with patterns of gradualism implied by his theory of natural selection.

Figure 2: Fundamental Patterns: Natural Selection treated as a Constant: Interspecific Assortative Mating Increases in the Evolution of Angiosperms



Darwin's classic finding that "no plant which is pollinated solely by wind has a brightly-coloured flower," may be explained in a new way, i.e., by a lack of interspecific assortative mating. Interspecific assortative mating involving bee species, insect species, and bird species and angiosperms explains the faster rate of evolution of angiosperm plants compared to ancestral species of plants (in which interspecific assortative mating is absent); it also explains the greater geometry of characteristics across angiosperm plant species compared to ancestral species of plants, including their greater variety of colors, patterns, structures, and "faces."

Analogous to the evolution of angiosperms, the evolution of primordial human species and humans is faster than the evolution of primates including chimpanzees, and also includes larger branching patterns of characteristics across individual organisms in the

evolution of the genus *Homo* and the human species. (Instead of Darwinist explanations and interpretations, the intelligences, capacities, talents, and personality characteristics of humans compared to primates may be analogous or partly analogous to the greater diversity and larger branching geometry of characteristics of angiosperm species compared to ancestral varieties of species).

Moreover, analogous to the evolution of angiosperms, increasing brain encephalization in the evolution of the genus *Homo*, including increasing structural and functional differentiation in the evolution of the brain, is analogous or partly analogous to the increasing branching geometry of characteristics of angiosperm plants compared to ancestral varieties of plants that do not participate in assortative mating with bees, insects, and birds.

Natural selection is commonly treated as a constant across animals including primates and chimpanzees; however, intraspecific assortative mating is not a constant: it has been increasing in the genus *Homo* as cultural growth has increased the qualities across individuals (similar qualities for assortative mating by ‘like with like’ and dissimilar qualities for mating across complementary characteristics or ‘opposites attract’). Given biological inheritance, increasing culture and assortative mating explains the increasing branching geometry of characteristics across individual organisms in the genus *Homo* (compared to chimpanzees and primates), including the increasing number and differentiation of faces and facial characteristics, body types and physical characteristics, and intelligences, personality characteristics, and talents.

It is an interesting question of the nature of the effects of intraspecific assortative mating in the evolution of humans and interspecific assortative mating in the co-evolution of angiosperm plants with bee species, insect species, and bird species: the number and differentiation of characteristics in the branching pattern of human individuals is far greater than primates, and the number and differentiation of characteristics in angiosperm plants is far greater than ancestral species of plants and non-flowering plants; thus, the complexity of characteristics across the branching patterns of individual organisms in the humans species, or across angiosperm species compared to non-flowering plants and ancestral varieties of plants increases, but the number of genes may remain constant or may actually shrink, suggesting that assortative mating may make the division of labor of genes of organisms and the

potential alternation of functions across genes more "efficient," i.e., once a certain level of the number of genes and organismal complexity has been established in the evolution of species, requiring fewer genes for greater complexity. In the investigation of the human genome project, numerous scientists estimated that the number of genes in the human genome would be much larger than the eventual findings of the human genome project: some scientists estimated that the number of genes would be 60,000 to 100,000 or more. In 2001, the journal *Science* published a review by Claverie: When estimates of the number of genes was revised down to approximately 30,000, J.M. Claverie commented in the journal *Science*: "That a mere one-third increase in gene numbers could be enough to progress from a rather unsophisticated nematode [Caenorhabditis elegans, with about 20,000 genes] to humans (and other mammals) is certainly quite provocative and will undoubtedly trigger scientific, philosophical, ethical, and religious questions throughout the beginnings of this new century. . . Neither the cellular DNA content . . . nor its gene content appears directly related to our intuitive perception of organismal complexity."[37] The number of genes of the human species has since been revised to 20,000 or slightly less.

12. Evolutionary Transitions in Natural Selection [1]

Asexual Reproduction in Species	Sexual Reproduction, Alternation of Generations (Increases capacity for number of offspring with differential characteristics)	Increase in Intensity of Natural Selection
Sexual Reproduction by High Number of Offspring & Low Physical and Parental Investment (Echinoderms, Fish, Amphibians)	Sexual Reproduction with Low Number of Offspring and High Physical and Parental Investment (Birds, Marsupials, Mammals)	Decline in Intensity of Natural Selection (e.g., technique of spawning compared to nesting or gestation).

On evolutionary transitions in the nature of natural selection, and its relationship to biological evolution: In a comparison of a population of clones to a random sample from the natural population from which the clones are derived, a number of quantities are reduced, i.e., the distribution of characteristics of the natural population collapses in the population of clones; however, it should be recognized that a logical exception is if the natural population is itself a population of pure clones. If an individual organism was taken at random from a natural population of clones to produce a population of clones, the population of clones would not reduce or collapse any distribution of quantities of the natural population since the natural population was itself a population of clones. Moreover, it is interesting to recognize that in a population of pure clones, the pattern of constant or near constant slight variations across individual members of species established by Alfred Russel Wallace and Charles Darwin collapses, and opportunities for natural selection are absent.

Thus, it may be recognized that in species of cloned organisms, such as asexual plants (e.g., ferns), the intensity or severity of natural selection is less than in species with sexual reproduction and recombination. In asexual species, genetic variability is more limited (consisting of mutation and polyploidy) compared to species with sexual reproduction and genetic recombination, or sexual reproduction, recombination, and the alternation of generations. Thus, it may be said that in the evolutionary transition from asexual reproduction in species to sexual reproduction, the intensity and severity of natural selection increases; however, by this standard, it also may be recognized that in the evolution of species the intensity and severity of natural selection may decline somewhat (even if it is still clearly present and an important force in evolution), as in the decrease in the number of offspring and the increase in the physical and parental investment in offspring by mammalian species (such as longer internal gestation, mammary glands, and parental investment), and also bird species and marsupial species compared to, say, the common though not universal technique of spawning of most fish species, most amphibians, or echinoderm species. Thus, natural selection may be treated as a variable that increases or declines in its severity or intensity with evolutionary transitions in modes of sexual reproduction and degree of parental investment (in addition to or independent of attempts to assess a complex set of

selection pressures in a given habitat or environment, and the severity or intensity of each).

13. Branching Patterns, Culture, & Biological Evolution: Scientists have long suspected that additional factors beyond Darwinism shape and organize biological variation including brain encephalization, including Darwin's co-discoverer Alfred Russel Wallace or linguist Noam Chomsky. In this work I have attempted to show that human biological evolution -- which is a branching pattern or series of branching patterns across linguistic groups of an increasing number and diversity of faces and facial characteristics, body types and physical characteristics, and behavioral characteristics including intelligences, personality characteristics, and talents -- is shaped by its co-evolution with culture and assortative mating.

An additional implication of the present work and theory is that human intelligence, and the intelligences, talents, and capacities of humans are not fixed or constant across ethnic, racial or different linguistic human sub-populations, but are variable. That is, *intelligences* and expressed and latent talents increase over generations as human sub-populations with more culture, such as high rates of literacy, or greater development of different aspects of culture, including the accumulation of different kinds of material culture or technology, and also the accumulation of different kinds of symbolic culture, including religion, philosophy, science, sports, arts, literature, theatre, film, and music, generate more and different patterns of assortative mating compared to human sub-populations with less culture. In principle, as suggested, declines in culture, cultural growth and cultural diffusion may stunt or reduce assortative mating, thus also stunting the acceleration of human evolution (compared to primates or primordial human species in the genus *Homo*).

In principle, declines in cultural capacity or cultural isolation reduce the capacity for assortative mating, and thus cultural isolation and a lack of cultural diffusion and growth may stunt or reduce assortative mating and thus the acceleration of biological evolution in the genus *Homo*, including stunting the increase of structural and functional differentiation in the brain related to higher intelligences and talents in the human species. If culture disappeared or collapsed, then assortative would decline, thus stunting or reversing the acceleration of evolution in the human species; however, there may be few or no instances of cultural decline to such an extent that the acceleration of

human evolution would reverse instead of merely stunting or reducing its acceleration. In principle, then, assortative mating varies directly with culture, which implies that societies with more culture have more assortative mating than societies with less culture, and groups and sub-populations with more culture have more assortative mating than groups and sub-populations with less culture. However, as suggested, it may be simpler to test the idea that, in the evolution of the genus *Homo*, *culture increases assortative mating*.

An important discovery of 20th century science, by Einstein and Eddington, was that light curves as it travels through space-time instead of traveling through Newtonian absolute space in straight Euclidian lines. A potentially important discovery of 21st century science is that higher intelligence, intelligences, and talents are not absolutely fixed or constant across racial and ethnic groups (as is normally assumed in Western and Eastern civilizations) but are variable.

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16. William F. Ogburn, *William F. Ogburn: On Culture and Social Change, selected papers*. (Chicago: University of Chicago Press, 1962). As suggested, Ogburn was the first scientist to claim that cultural growth is exponential: that early simple societies for most of human history had small amounts of culture and technology, and slow rates of cultural accretion, and that early modern and modern societies have had much faster rates of cultural and technological growth as the base of culture, including a larger base of combinations of existing technologies and inventions, have increased. From a more microscopic or "fine-grained" perspective, the development and success of different patterns in symbolic culture may facilitate or play a role in technological invention and growth. In what languages and mathematical systems do individuals or groups contribute potential scientific and technological revolutions? For Copernicus, Galileo, and Newton, exposure or fluency in Latin, Greek, Euclidean geometry, and Arabic numerals may have been cultural prerequisites for their scientific revolutions, and they may have been cultural prerequisites for technological advances and revolutions by their contemporaries (i.e., Europe and the West were technologically behind the Arab and Muslim worlds, and also China, before Fibonacci's revolution in cultural diffusion spreading Arabic numerals and the decimal system to Europe). From Ogburn's perspective, the greater political diversity and linguistic diversity of Europe may have facilitated greater cultural diffusion of ideas and technologies compared to the early modern Muslim world or China, once Europe had reached a level of development that it could compete with the Muslim world and China. From the standpoint of human evolution, the invention of new technologies that may have exponential rates of growth, like increasing computing power described by "Moore's Law," are special cases of Ogburn's Law. There are debates in the literature as to whether some sets of technologies, and also societies themselves, may plateau in technological development and growth. However, brief technological plateaus may be overtaken by unexpected inventions and combinations of technologies over the longer term. From the standpoint of human biological evolution, this paper

addresses how patterns of cultural growth interact with and co-evolve with human biology: Does exponential cultural growth in human evolution described by Ogburn's Law interact with and co-evolve with human biology? Does cultural growth co-evolve with human biology by more than what physicists call "action at a distance"?

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